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Abstract: PURPOSE OF REVIEW Multiparametric MRI has gained tremendous importance in the daily practice for patients at risk or diagnosed with prostate cancer. Interpretation of multiparametric-MRI is a complex task, supposedly restricted to experienced radiologists. The purpose of this review is to analyze fundamentals of multiparametric-MRI interpretation and to describe how multiparametric-MRI training could be organized. RECENT FINDINGS Recently, professional guidelines have been published to provide technical and interpretation frameworks and harmonize multiparametric-MRI practice, but the question of physicians training in prostate multiparametric-MRI reading is still pending. What kind of education, practice, and training makes a radiologist able to reliably interpret a prostate multiparametric-MRI? How can findings be reported to be easily understood? How much experience is needed? How can we train urologists and other physicians to review the examinations they request? Is double-reading necessary? SUMMARY An institutional-based competency certification process for prostate multiparametric-MRI interpretation may encourage nonspecialized radiologists to qualify for prostate imaging in a standardized and reproducible way, exactly as urologists need it.

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Recent findings
Recently, professional guidelines have been published to provide technical and interpretation frameworks and harmonize multiparametric-MRI practice, but the question of physicians training in prostate multiparametric-MRI reading is still pending. What kind of education, practice, and training makes a radiologist able to reliably interpret a prostate multiparametric-MRI? How can findings be reported to be easily understood? How much experience is needed? How can we train urologists and other physicians to review the examinations they request? Is double-reading necessary?

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An institutional-based competency certification process for prostate multiparametric-MRI interpretation may encourage nonspecialized radiologists to qualify for prostate imaging in a standardized and reproducible way, exactly as urologists need it.

Keywords
education, guidelines, interpretation, MRI, prostate, reporting

INTRODUCTION

Over the last decade, the developments in MRI technology have established the role of multiparametric prostate MRI for the detection, staging, surveillance, and treatment planning of prostate cancer. In experienced hands, this examination allows distinction of significant cancers requiring a potentially invasive treatment, from indolent cancers that only require active surveillance.

Physicians ordering prostate MRI, and especially urologists, need to be confident regarding the MRI report they receive, because the decision-making process (e.g., if or not to treat a patient with prostate cancer) depends among other things on the count, location, and radiographic stage of lesions given by the radiologist. Today, unless they personally know the radiologist who performed the examination, they have no rational clue on how reliable the final report is, and still, many of them believe that multiparametric-MRI should be left to the experts.

In an effort to codify prostate MRI protocols, interpretation and reporting, to provide indicators on MRI quality, as well as to standardize the practices, professional guidelines such as European Society of Uro-Radiology's (ESUR) and American College of Radiology's (ACR) Prostate Imaging-Reporting and Data System (PI-RADS) have recently been published [1,2]. It is a real step forward for the adoption of imaging in prostate cancer management.

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KEY POINTS

- Prostate multiparametric-MRI review is accessible to all physicians after training, but interpretation is the duty of radiologists.
- Prostate multiparametric-MRI reading requires technical, clinical, and interpretation skills.
- Recent professional guidelines including standardized prostate map and PI-RADS score allow widespread adoption of a common interdisciplinary knowledge base.
- Although no indicator is available to quantify 'experience', there is a consensus in literature that full analysis of 50–100 cases is required to become autonomous.
- Temporary double-reading and organized certification may help beginners reach expertise in a structured and faster way, and increase urologists' confidence in prostate imaging.

Nevertheless, even when the examination is technically optimized, a significant interobserver variability remains in reporting prostate MRI findings. Basically, a reader accuracy depends on three skills: the ability to identify a clinically significant lesion within the parenchyma (to distinguish it from normal or inflammatory tissue); to rule out a number of false-positive images and preserve multiparametric-MRI's high negative predictive value; to assign a reliable PI-RADS and staging score for each lesion.

Currently, it is to be established what makes a radiologist (residents, nonspecialized practitioners, and others) efficient and autonomous in these three basic interpretation skills, what comes from knowledge, and what comes from experience. Some authors have shown that young residents, having a simple training, could yield similar accuracy as experts [3,4▪▪]. In a recently published study, there was a significant improvement in diagnostic accuracy after a 2-year study period with almost doubling of the cancer detection rates.

In this review, we will consider the training requirements for urologists and radiologists on how to read MRI.

WHAT DO UROLOGISTS (AND CLINICIANS) EXPECT FROM PROSTATE MULTIPARAMETRIC-MRI?

Urologists and other clinicians (radiation therapists, oncologists, pathologists, etc.) can not be specialized in imaging, MRI, and prostate image interpretation, but they should be able to recognize lesions from report without assistance (for instance by using corresponding slice number(s) on the anatomical T2-w series) as they will be in first line to show suspicious lesions to the patient, to coregister magnetic resonance and ultrasound data in case of fusion biopsy or image-guided treatment in the operating room (high intensity focalized ultrasound or other focal therapy techniques, etc.) [5]. They need landmarks on protocol quality and conformance to guidelines to check that the examinations they request are correctly performed.

According to recent guidelines, physicians appreciate standardized MRI prostate reporting of lesions along with a prose report [6–8]. Several items on what urologists (and clinicians) expect from prostate multiparametric-MRI data, and from its standardized reporting are detailed in Table 1.

BASIC STEPS OF MULTIPARAMETRIC-MRI INTERPRETATION AND REPORTING

Localization of suspicious lesions on multiparametric imaging

The first step of the interpretation process is to detect foci suspicious for clinically significant cancer within the gland. This requires a knowledge of prostate cancer's natural history, gland anatomy and radioanatomy, cancer and benign tissue semiology. In a recent article [5], we encouraged a systematic and independent review of each of the three main compartments of the gland: peripheral zone, transition zone, and then anterior fibromuscular stroma, as each one has a slightly different semiology. Such analysis allows faster reading, and review of the entire gland, without omission.

Scoring and staging of suspicious images

Once detected, the second step is to provide a degree of suspicion of malignancy for all significant images. This classification can be qualitative or quantitative (with a score). Classifications are always based on semiology criteria, but these latter are numerous (up to 14 per lesion), often subjective, sequence-specific, and complicated by multiples exceptions (size, location, etc.) [4▪▪,5,9]. Thus, the main complaint of urologists is the subjectivity, complexity, and low reproducibility of multiparametric-MRI [10,11].

In 2012, following a consensus conference [6], ESUR published professional recommendations [1] in an effort to harmonize practices.

They introduced the PI-RADS score to help classify multiparametric-MRI lesions. An updated version of this score is available [2]. Several studies have shown good accuracies of the PI-RADS for classification of suspicious images [4▪▪,12▪,13▪,14],

Table 1. Main expectations from urologists regarding prostate multiparametric-MRI data and standardized reporting

	Urologist needs	Use of standardized multiparametric-MRI
1	To improve his skills in reading/understanding MRI images	Standardized prostate map will help. This easy-to-read document will make the urologist confident in showing the lesions to the patient and explaining biopsy and treatment strategies. Frequent multifocality of images suspicious for prostate cancer at MRI deserves this visual report.
2	To improve his accuracy in targeting biopsy or in focal therapy planning and procedure	Precise information such as suspicious lesion location, contours, and extent in relation to zonal anatomy boundaries is crucial. Information resulting from multiple MRI sequences reading synthesis by the radiologist is best provided on an annotated scheme. MR images themselves can also be annotated or included into the report for TRUS/MRI image fusion procedure purpose.
3	To improve his quality of surgical dissection at the time of radical prostatectomy	Relationships between tumor contours and glandular surface of the prostate are valuable informations for sparing periprostatic tissue such as neurovascular bundles, bladder neck, and for preparation of the apex.
4	To provide the pathologist an easy-to-read document at the time of biopsy or radical prostatectomy specimen examination and/or result discussion	This will improve pathology report and any retrospective assessment of patient workup when all physicians discuss the case in multidisciplinary team meeting.

and moderate to good inter-reader agreement between readers. Two studies suggest that the PI-RADS score could be used as a triage test for selecting patients with suspicious images requiring target biopsies or conversely to defer biopsy procedure, depending on high (4 and 5 out of 5) or low (1 or 2 out of 5) PI-RADS score, respectively [15,16]. However, PI-RADS has few drawbacks:

(1) Several studies have shown that PI-RADS accuracy and reproducibility for prostate cancer detection was slightly lower than pre-existing subjective scoring techniques [4▪▪,14,17], suggesting that PI-RADS criteria do not completely reflect, at the moment, components of an expert's judgement.
(2) A large proportion of significant MRI images remain 'equivocal' (score of 3 out of 5) and cannot clearly be classified. Strict application of semiology criteria could overcome this drawback [13▪], such as use of computer-aided diagnosis (CAD) systems either using atlases, computerized decision systems, or automatic analysis [18,19,20▪,21–24], new MRI sequences [25,26], biomarkers [27] or new postprocessing algorithms that may be included in next PI-RADS versions.

Reporting of significant images

Format, content, and terminology

There is great variability in the way multiparametric-MRI is reported (conventional free-text, semistructured report, description of lesions with or without suspicion score, use of PI-RADS or different score, addition or not of schematic prostate map or key images, etc.) [5,8,28–32,33▪]. It has been proven that referring physicians prefer structured reports, and that structured reports are evidence of the reader's training and knowledge in the domain [34].

Prostate MRI reports should include all relevant information to allow use of multiparametric-MRI data under all circumstances (consultation with the patient, patient himself, multidisciplinary meeting, further comparison, follow-up, double-reading, etc.), and easy data collection or comparison. Therefore, according to most authors [1,2,5–7,30,31,33▪], its format has to be structured, and its content to be in a standardized and understandable terminology. We describe a framework and the fundamental content of a standardized prostate multiparametric-MRI report in Table 2.

ESUR guidelines include a dedicated section describing key elements for the reporting of this examination [1]. The primary objective of this approach is to harmonize practices in Europe, but thanks to a virtuous circle [35], structured reporting allows wider promotion of guidelines, quicker adoption in radiology and urology, and in the case of PI-RADS an extension outside Europe, to the rest of the world [2]. The recent ACR/ESUR joint work on PI-RADS version 2 includes a detailed glossary of terms, in an additional effort to harmonize the terminology [2]. Recently, Silveira *et al.* [33▪] an improvement prostate multiparametric-MRI quality reports

Table 2. Framework and fundamental content of a standardized prostate multiparametric-MRI report

Header	Patient information	Name
		Institution
		ID
		Date of birth
		Coordinates
	Study information	Study date, time
		Study description
		Study unique identifier in the institution (accession number, etc.)
		MRI equipment (manufacturer, magnet strength, coil(s))
		Patient preparation (enema/spasmolytic/etc.)
		Protocol (list of series performed for the multiparametric-MRI), with potential changes or artifacts
	Patient history/clinical indication	Age
		PSA in the last 3 months, and, if available, previous PSA
		DRE findings
		Family history of PCa
		History and/or presence of functional signs, inflammatory, or infectious signs
		History of functional prostate surgery (TURP, etc.)
		History of androgen deprivation or substitution therapy
		History of PCa with or without treatment, and initial PCa location
		History of previous biopsy series
		Prior films/studies reviewed (e.g., Comparison with study dd/mm/yyyy)
	Context of current examination	• Before a first series of biopsies (S1)
		• Before a second series of biopsies (S2) with previous negative, including date and institution where biopsies where performed (ideally report)
		• Before a nth series of biopsies (Sn) with previous negatives, including dates and institutions where biopsies where performed (ideally reports)
		• After a positive series of biopsies, with precision of date, positive cores, and significance of biopsies (report if available)
		o Patient with significant cancer requiring local staging
		o Patient with insignificant cancer requiring confirmation for active surveillance inclusion
		o Patient under active surveillance
		• Biological recurrence after radical prostatectomy
		• Biological recurrence after external radiotherapy
		• Biological recurrence after brachytherapy
		• Biological recurrence after focal therapy (HIFU, cryo, VTP, laser, etc.)
Findings	Measurement of the gland	Dimensions (x, y, z planes; volume in cc)
		Presence or not of a median lobe
		Surgical sequels (TURP)
	Background signal	Description of the global aspect of each of the three prostate compartments (peripheral zone, transition zone, AFMS), introducing signal changes and potential artifacts hampering the description of significant images (hemorrhagic changes, scars, atrophy, etc.). Example: Peripheral zone shows bright high intensity T2 signal, with no hemorrhagic artifact; peripheral zone shows few nonhemorrhagic signal changes that do not hamper interpretation
		Presence of significant anatomical landmarks: cysts, calcifications, and so on

Table 2. (*Continued*)

	Significant images	Clear enumeration of their count. Example: peripheral zone analysis shows two significant images
		Separate description of each image, from the most suspicious (or biggest) lesion (index lesion) to the least, including
		• Appearance, as described in PI-RADS 2.0 lexicon (diffuse abnormality/nodule/mass, etc.)
		• Shape
		• Margins
		• Location (with reference to the standardized map sector, completed by explicit translation in reference to zonal anatomy). Example: . . .in right mediolobar mid-gland peripheral zone (z03p). . .
		• Additional information of locating the lesion on the MRI data, particularly series and slice number (e.g., Series 0101; Slice 10-13, center 12)
		• Size (in mm); ideally three planes, but x and y are fine
		• Signal description in each series (T2, DWI, DCE, etc.)
		• Suspicion score of malignancy (including objective, and subjective score if (and only if) different from the objective one). Example: '. . .with a PI-RADS v2 score of 3/5, but more likely 4/5 based on our experience. . .'
		• Suspicion score of extracapsular extension (based on PI-RADS v1 classification or PI-RADS v2 staging terms), with supposed radial extension depth in mm.
		• Suspicion score of seminal vesicle invasion for lesions involving prostate base
		• Suspicion score of sphincter invasion for lesions involving prostate apex
		• Reporting of ALL lesions previously described on a standardized 27 or 39 sectors map. This reporting should be performed on a copy of a standardized map provided by current guidelines, including manual or electronic drawing of lesions, with position and size relative to the schematic gland. Lesions having a suspicion of ECE should clearly have margins outside the contours of the schematic prostate slice
		• Illustrative key image(s) can be included in the report, to facilitate recognition of significant images on the multiparametric-MRI series
	Locoregional staging	• Report of pelvic nodes
	Metastatic staging	• Report of potential bladder, periprostatic muscle, or rectal invasion
		• Report of potential bone lesions
	Other findings	For example, hypertonic bladder with small diverticules; left iliac aneurysm
Overall impression/conclusion	Conclusion should clearly conclude either	
	• that MRI is normal, showing no significant image in a gland with a completely normal background signal. . .	
	• . . .or that MRI shows no significant image, with reserve of signal changes, that should be quantified (slight/important). . .	
	• . . .or that MRI shows one or more significant images, with score either $\geq$ or $>$ to 3/5, that require targeted biopsy. If so, count, laterality and brief description (size, local and locoregional staging) of the two most significant lesions should be repeated	
Signature(s)	Single reading	Name, date, position, and signature
	Double reading (optional)	Additional physician information, completed by
		• Confirmation of primary reading without remark
		• Remarks not changing primary reading
		• Remarks having required consensus reading

AFMS, anterior fibromuscular stroma; DRE, digital rectal examination; DWI, diffusion weighted imaging; ECE, extracapsular extension; HIFU, high intensity focalized ultrasound; PCa, prostate cancer; PSA, prostate specific antigen.

by using a structured template and informatics tools to generate it in routine.

Report appendices

In addition to the structured reports, a copy of a standardized prostate map, as described in current guidelines [1], with manual or electronic drawing of lesions (Fig. 1), position, and size relative to the schematic gland, as well as key images for the index lesion should be included in the final report, to help physicians localize, recognize the most suspicious lesions [5,30,31,36,37▪]. Lesions having a suspicion of extracapsular extension should clearly have margins outside the contours of the schematic prostate slice [37▪]. It is unclear whether a 16, 27 [38], or 39 [2] sectors prostate map is optimal for the

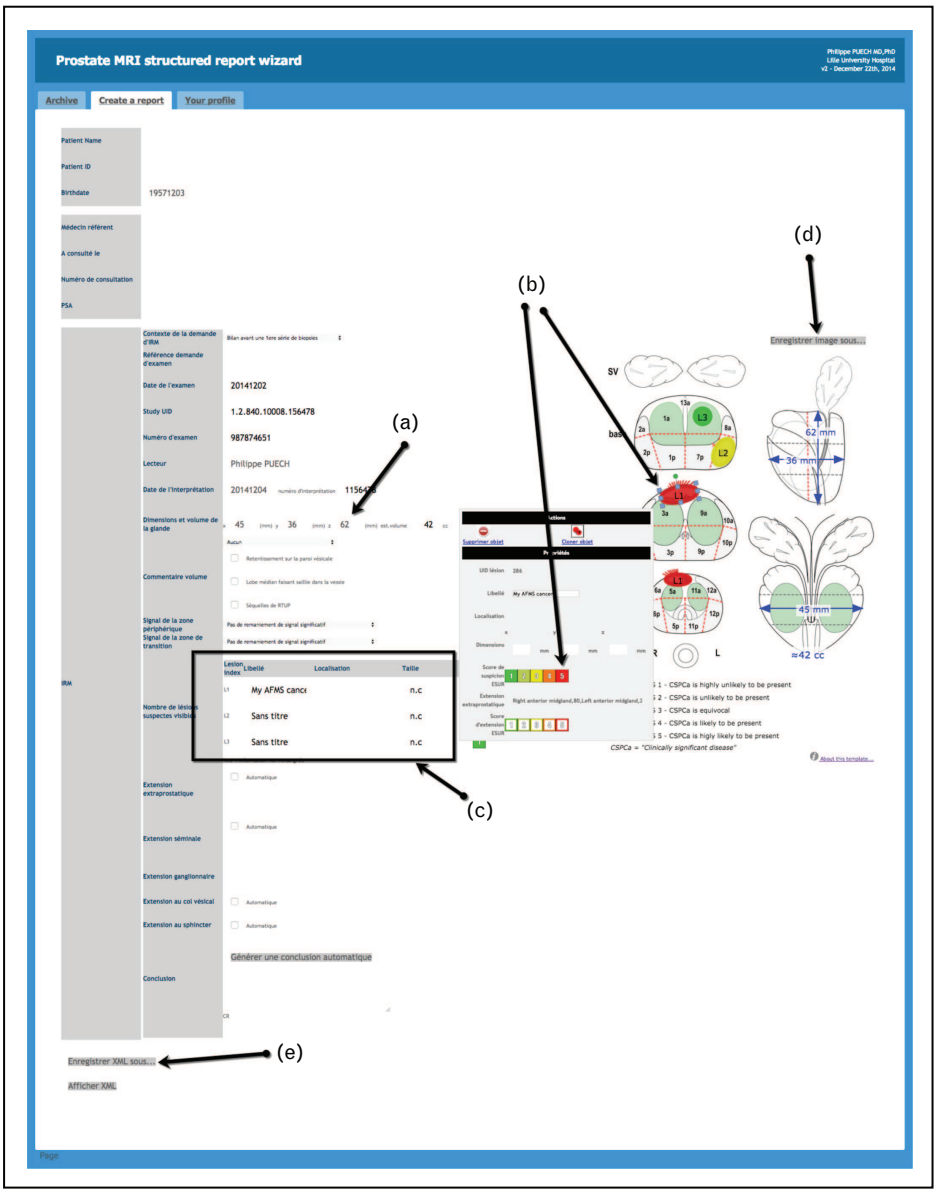

FIGURE 1. Webpage capture of a computer-assisted reporting online tool (http://www.pcih.fr/mpmri). It is possible to create a report online from scratch. Patient and study information are automatically retrieved from source. Clinical data and interpretation findings are manually reported on the form (a). Relevant information is automatically drawn on a standardized (27 sectors) prostate map. It is possible to interactively double-click on the image to create new lesions, adjust their position, size and rotation. Each lesion can be given a PI-RADS score and additional data (b). Lesions report is automatically generated in the form (c). Resulting schematic drawing can be exported to picture (d) for inclusion in the definitive report or radiology information system, and easily exported as a structured XML file that can be archived or transmitted electronically (e). PI-RADS, Prostate Imaging-Reporting and Data System.

localization of lesions; however, all schematic representations of the prostate divide the gland in three craniocaudal sections (base, mid-gland, and apex), with similar functionality [1,2,5,31,37▪,38,39].

Tools for interpretation

Several information technology tools are required to ensure optimal and comfortable image interpretation and reporting:

(1) First, the most important is a dedicated interpretation software, able to display multiple series simultaneously, and sync them in three-dimention. Depending on the context (fast review, standard or extended multiparametric-MRI protocol), up to 20 series of images have to be synchronized in real-time, as shown in Table 3.
(2) Second, a database dedicated to prostate imaging allowing the tracking of activity, data collection and sharing, patient follow-up, disease management (pending results, correlation, etc.), key image collection, teaching.
(3) Third, CAD software that may help radiologists detect or characterize suspicious images [18,19,20▪,21–24].
(4) Last, new computer-assisted reporting tools are promising additions to radiology information system, or prostate-specific databases, for data collection and sharing, and rapid building of standardized reports [33▪,37▪,40▪,41].

LEVELS OF COMPETENCE IN MULTIPARAMETRIC-MRI READING

(1) Image-review is a simplified set of technical and reading skills, sufficient to meet the requirements of physicians prescribing and using multiparametric-MRI routinely (urologists, radiation therapists, medical oncologists, pathologists). Image review basically consists of recognizing and localizing the lesion(s) described on the report, to put it in the clinical context of the patient, and take full advantage of imaging for patient management.
(2) Image interpretation is the ability to search, select, and describe relevant information on the images, in order to answer a clinical question rose by a referring physician. Interpretation leads to the reduction of a report, and engages the radiologist's responsibility. Only appropriately trained physicians should carry out this duty. In addition to technical skills (MRI physics, acquisition of images), interpretation requires knowledge of prostate diseases, radioanatomy, semiology and its variants, and a capacity to transcribe these findings into an intelligible report that will be useful in the management of the patient. All of this is part of the curriculum of radiology trainees, and partially available in CME programs or congress sessions.

Table 4 summarizes differences between image interpretation and image review.

Table 3. Count of images that have to be simultaneously displayed on screen and analyzed by a physician for interpreting minimal, standard and extended multiparametric prostate MRI protocols, and for the secondary review of a standard multiparametric-MRI protocol

Protocol	Sequence	Simultaneous images	Minimal multiparametric-MRI interpretation protocol	Standard multiparametric-MRI interpretation protocol	Standard multiparametric-MRI review	Extended multiparametric-MRI interpretation protocol
T2	Axial T2-w	1 image	●	●	● (axial)	●
	Sagittal and coronal T2-w	1–2 images	●	●		●
DWI	Axial DWI trace	2–4 images	●	●	● (higher b)	●
	Axial DWI ADC map	1–2 images	●	●	●	●
DCE	Axial DCE (subtracted or not)	6–8 images	●	●	● (earliest subtracted)	●
	Axial DCE parametric maps	0–3 images				●
MRSI	Axial MRSI	1–2 images				●
Simultaneous images count			7	14	4	20

These numbers are based on authors' practice.

Table 4. Differences in knowledge, practice and responsibilities between image interpretation and image review

	Image interpretation	Image review
Knowledge of MRI physics	●	
Knowledge of MRI contra-indications	●	
Knowledge of clinical indications	●	●
Capacity to interrogate and inform patient	●	●
Selection of adequate imaging technique	●	
Protocol design	●	
Data acquisition and sequence tuning	●	
Protocol conformance to professional guidelines	●	●
Image quality control	●	
Localizing suspicious lesions on multiparametric imaging	●	●
Knowledge of detailed semiology (including false positives and negatives) on each MR sequence	●	
Basic cancer semiology		●
Localizing lesions described on a free-text report	●	●
Localizing lesions described on a schematic prostate map	●	●
Scoring and staging of suspicious images	●	
Estimation of lesion growth or changes between two examinations	●	
Pelvic imaging basics (recognizing normal organs, nodes, bone, etc.), and ability to detect other disease	●	
Knowledge of potential therapeutic strategies, related to imaging (dissection, treatment planning)	●	
Reporting findings	●	
Structured reporting of findings	●	
Report signature and legal archiving	●	
Double reading/expertise	●	
Correlation of disease and MRI reports	●	●
Certification required	●	
CME required	●	
Fast reading possible (report is done)		●
Systematic reading is mandatory (first interpretation)	●	
Legal responsibility of the reader engaged	●	

Reader's experience

Both image interpretation and image review benefit from the reader's experience [3,42,43], but there is no established indicator of that experience in practice, and no study has investigated the time necessary to finish the so-called 'learning curve' [44,45]. Radiologists fulfill it at different speeds, depending on their abilities, their investment, and the number of cases they have analyzed. There are several classes of 'experience' for image interpretation in the literature, usually expressed by the years in practice: nonexperienced; 'experienced' (2–3 years), and 'of high experience' (>5 years). Readers having about 2 years of experience in genito-urinary imaging are usually considered as experienced. Depending on center size, this represents between 400 and 1200 cases (5–15 cases a week) with full analysis of indications, clinical settings, multiparametric-MRI images, histology feedback, and patient outcome. Yet, there is no rational relationship between the years or number of cases of experience, and an established 'experience' or 'high experience' status. Two recent articles, including a consensus conference agreed on a minimal number of 50 patient cases [31,46] to be considered as sufficiently trained to read multiparametric-MRI. Additionally, the quality of initial training, the ability to easily review, share, or discuss difficult cases with colleagues and to get high-quality disorder feedback can certainly balance this purely quantitative approach of what is called 'experience'.

After initial education (1–2 days seminary dedicated to prostate multiparametric-MRI reading), a radiologist should be considered as able to read the examinations but under a second reading performed by an experienced reader. After an intermediate

Table 5. Proposition of progressive training and practice phases for prostate multiparametric-MRI interpretation qualification

Training phase	Certification in MRI and ultrasound technique and pelvic imaging
	Certified initial training in prostate imaging
Start-up phase (level II)	50–100 interpretations on site, in real-life clinical conditions
	Systematic double-reading (local or remote) of all cases
	Registry of double-reading discrepancies and progression in time
	Pathology and clinical feedback of patients
	Participation to multidisciplinary meetings to ensure contact with urologists, pathologists and other physicians, as well as CME
Route phase	More than 5 prostate multiparametric-MRI interpretations per week
	Pathology and clinical feedback of patients
	Participation to multidisciplinary meetings to ensure contact with urologists, pathologists and other physicians
CME	Evidence of regular participation to CME sessions on prostate imaging, prostate diseases and disease, prostate cancer therapy
	Scientific watch through specialized literature in urology and in Imaging
	Technical survey

period of 50–100 cases modulated by the mutual appreciation of the interest of this process, they should be considered as 'experienced' and work autonomously. Quantification of first and secondary readings concordances in time may help determine the optimal duration of this intermediate phase. In centers having only one radiologist dedicated to prostate MRI, double-reading could be achieved with help of remote tele-expertise services.

Table 5 summarizes the main elements that may be required to ensure experience and qualification in prostate multiparametric-MRI interpretation.

Double-reading

Multiparametric-MRI interpretation is always a challenging task, especially for the less experienced readers. Double-reading is commonly used in original research studies to improve multiparametric-MRI reading robustness, to reduce the risk of missing significant images due to human mistake [4▪▪,12▪,15,47]. Double-reading may be of interest depending on initial findings:

(1) To confirm negativeness of multiparametric-MRI and consolidate its negative predictive value (NPV) in cases with PI-RADS 1 or 2;
(2) To improve classification and selectivity in cases with PI-RADS 3;
(3) To improve local staging accuracy in cases with high risk PI-RADS 4 or 5.

However, there is no evidence to date, that this process can improve prostate multiparametric-MRI accuracy in routine, as it does for breast imaging, whose classification is also based on a standardized score [48–50]. Further studies, based on prospective evaluation of large routine series of prostate multiparametric-MRI are still expected.

In our experience, double-reading is especially interesting in the startup-phase of prostate imaging training, as readers with low experience tend to describe typically false-positive images, or still need methodological assistance. Further studies will be required to answer this question in the future.

Standard levels of competence

On the basis of previous observations, and similarly to what other disciplines did [51], it is possible to propose three standardized levels of competence in prostate multiparametric-MRI reading:

(1) Level I: experience on selecting the appropriate diagnostic modality, reviewing images, and using the results. This level does not include performing the technique.
(2) Level II: having achieved initial training, with practical experience in image interpretation but with cover of a double-reading.
(3) Level III: able to independently perform and interpret the examination under all circumstances, with confidence, without double-reading.

TRAINING

General aspects of training in prostate multiparametric-MRI

The European Society of Radiology has published a description of three levels of training, consistent with a forementioned levels of competence. Levels I and II correspond to years 1–3 and 4–5 of residency training periods, respectively. Level III corresponds

to a subspecialization beyond the fifth year of training [52]. Level I training in uroradiology includes 'understanding of imaging features and differential diagnoses of pathologies of the prostate, seminal vesicles, and testes/scrotum'. Level II training includes 'description of zonal anatomy of the prostate' and 'description of imaging features of prostatic zones with ultrasound and MRI', as well as 'inflammatory and tumoral disorders of the prostate'.

In order to specialize in prostate MRI (and reach a level III competence), radiologists need to acquire advanced clinical and interpretation skills specific to prostate cancer. They benefit of a level III baseline technical background. Inversely, urologists and other physicians have a strong (level III) baseline clinical background that radiologists do not, but usually no education in MRI physics (level I), and only basic (level I or undergraduate) reading skills. Consequently, physicians with different specialties and levels of knowledge will share a common base of technical, clinical, and interpretation skills, and will have to deepen each of them, depending on their background, in order to review or interpret prostate multiparametric-MRI, and use it at its best.

Table 6. Sample of online or on-site courses designed for prostate multiparametric-MRI interpretation training

Online courses	ICPME courses	http://courses.icpme.us/uploads/pdf/workbook332.pdf
	Prostate Cancer Imaging – iPad app; 30–50 cases	https://itunes.apple.com/us/app/prostate-cancer-imaging/id535301775 http://www.pcih.fr/ipad
	Educational Symposia – multiparametric-MRI and MR-guided intervention – video CME DVD	http://www.edusymp.com/product/details/635
	ARRS prostate MRI online course	http://www.arrs.org/prostatemri/
On-site courses	ESUR teaching course on prostate MRI (annual) – 2 days; 06/2015; Different cities of Europe (Paris, Girona, Nijmegen, Istanbul, Antwerp, etc.); 40 cases; different manufacturers	http://www.esur.org/
	UCLA radiology; CME course 'Evolving role of MRI in Prostate Cancer management'; 1 day; lectures and hands-on sessions	http://radiology.ucla.edu/body.cfm?id=203
	ESMRBM Prostate Image Analysis course – 2 days -2/2/2015; lectures and hands-on sessions (50/50%); 46 cases; Paris, FR	http://www.esmrmb.org/index.php
	Lille prostate MRI workshop (8th session); 2 days (11/2015); lectures and hands-on sessions on iPad; Annual; Lille, FR; 40 cases	http://www.pcih.fr/alip
	Pelican Courses for Cancer Specialists; Annual; 3rd session; 1 day; Annual; Basingstoke, UK	http://www.pelicancourses.org/
	Prostate multiparametric-MRI reading and MRI-guided biopsies (07/2015); 3rd session; annual; Cambridge, UK	http://www.camurology.org.uk/
	Prostate MRI and MR-guided Intervention Course (07/2015); Indian Wells, California, USA (Annual); 2 days	http://desertmedicalimaging.com/continuing-education/
	Asia Pacific Prostate MRI course; 2nd session; Melbourne, AU (07/2015)	http://prostascan.com.au
	Hands-on prostate MRI workshop; 2nd session; 1 day; lectures and workstation cases; Montreal, California, USA	http://www.innovativeurology.org/
	Prostate Cancer Masterclass (during PCa World Congress) Cairns, AU (08/2015), 2 sessions; 1 day; lectures and 30 cases on workstations.	http://prostatecancercongress.org.au/masterclass es/
	ICIS (International Cancer Imaging Society) Workshop; Masterclass in Imaging of Prostate Cancer; 1 day; lectures and 35–40 cases on workstations; London, UK	http://www.icimagingsociety.org.uk/
	Hands on prostate MRI (10/2014); Hands-on session; Cases on workstation, Scottsdale, Arizona, USA	http://www.mammographyed.com/course-list
	AUA courses	https://www.auanet.org/education/

Table 7. Program of a theoretical CME course designed for radiologists and other physicians, with technical, clinical, and interpretation training pathways, and corresponding requirements in knowledge

Clinic		Required level of competence
	Prostate cancer epidemiology	1
	Clinically significant cancers	1
	Clinical indications of MRI	1
	Detection	
	Active surveillance	
	Staging	
	Recurrences	
	Treatment planning	
	Anatomy	1
	Morphometric histopathological basis for MRI interpretation	1
	Fundamentals of prostate cancer management (active surveillance, surgical, radiation, and focal therapy)	1
Imaging technique		
	Magnets and coils	2
	T2 imaging	2
	DWI imaging	2
	DCE imaging	2
	MRS imaging	3
	Multiparametric and other protocols	1
	MRI protocol tuning	3
Interpretation		
	MRI radioanatomy	1
	Peripheral zone cancers	1
	Transition zone cancers	1
	AFMS cancers	1
	Benign images and common pitfalls	1
	False-positive images	2
	MRI accuracy and limitations for PCa identification	2
	Local staging using MRI	2
	Node imaging	1
	Bone metastasis	2
	Normal posttherapeutic imaging	2
	Imaging of PCa recurrences	2
Reporting		
	What the urologist wants to know	1
	Rationale for structured reporting	1
	Standardized lesion localization	1
	Scoring techniques (Likert, PI-RADS, etc.). Description, and how-to apply them	1
	Elements of a standardized structured report	1
	Use of reporting information for target biopsies	2
Interpretation training		
	Normal anatomy	1
	Typical peripheral zone cancer	1
	Typical transition zone cancer	1
	Typical AFMS cancer	1
	Multifocal and whole gland cancer	2

Table 7 (*Continued*)

Clinic		Required level of competence
	Prostatitis	2
	Benign prostate hyperplasia	1
	Cancer follow-up under AS	2
	Lesions misdiagnosed by systematic posterior TRUS biopsies – target biopsies	2
	Recurrence after prostatectomy	3
	Recurrence after radiation beam therapy	3
	Recurrence after focal therapy	3
	Discrepancies between DCE and DWI imaging	3

AFMS, anterior fibromuscular stroma.

Initial education is the cornerstone of prostate multiparametric-MRI reading. In 2009, Akin *et al.* [3] showed significant increase in diagnostic accuracy with area under the ROC curve climbing from 0.52 to 0.66 after a single didactic education, and remaining stable after a 200 cases training curriculum. In a series of 31 cases read by five readers, Garcia-Reyes *et al.* [53▪] showed that a single dedicated education allows significant increase of accuracy (from 74.2 to 87.7% for index lesion detection and from 54.8 to 73.5% for Gleason assessment) and reader confidence.

Usually, dedicated education in prostate MRI is part of the genitourinary imaging curriculum, or performed during a period of fellowship. Nonspecialized radiologists will be able to get it through various CME programs that are frequently opened to urologists and other physicians.

Available material

Currently, there are numerous teaching courses on prostate MRI provided all over the world. As coaching is increasingly important, online, web-based, and even tablet-based prostate MRI analyzing tools have been developed to support radiologists [4▪▪]. In Table 6, we collected a selection of teaching material or dedicated courses available online, or regularly repeated. Many are live CME courses focused on image interpretation (with 'hands-on' sessions), and consequently aimed at radiologists. However, provided that basic training in technique is acquired, many of them will be accessible to urologists. CME courses usually include didactic lectures and interactive practical sessions tailored to meeting the level of knowledge of the audience. In Table 7, we present the program of a theoretical CME course typically designed for radiologists and other physicians, with technical, clinical, and interpretation training pathways, and corresponding requirements in knowledge.

Certification

There is currently no certification in prostate multiparametric-MRI interpretation. Certificates of attendance for masterclasses or live CME courses are available to testify involvement into a level I competence process. An experience of prostate multiparametric-MRI reading in a specialized imaging department during a traineeship, residency or assistantship, with an experience of about 50–100 cases may testify of a good experience, but what makes a radiologist completely autonomous and experienced in prostate imaging remains to be delineated. No trainee assessment program had been published to date. A scalable process, from level I to level III of competence should be organized and validated by the institutions or third party organizations [54].

CONCLUSION

Because of its increasing importance in prostate cancer management, a structured training is required for radiologists willing to interpret prostate multiparametric-MRI. Urologists, as well as other specialists also need to learn how to review this examination, as they need it daily for clinical decisions, treatment planning, or transrectal ultrasound/MRI fusion procedure purposes. Education includes technical, clinical, and image interpretation fundamentals. Currently, there is plenty of teaching material available for this purpose, but initial education must be consolidated with a practical experience in image interpretation (or review). Prior to being considered as experienced readers, we believe radiologists could benefit of a temporary intermediate competency certification process based on the experience of 50–100 cases and supervised by a systematic double-reading. This may encourage nonspecialized radiologists to involve in prostate multiparametric-MRI, and ensure they can perform, interpret and report this examination

in a standardized and reproducible way, exactly as urologists need it.

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Conflicts of interest

There are no conflicts of interest.

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